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(71) Applicant : **Kimura, Takayuki**
3307 Watari-cho
Sakaiminato City, Tottori 684 (JP)

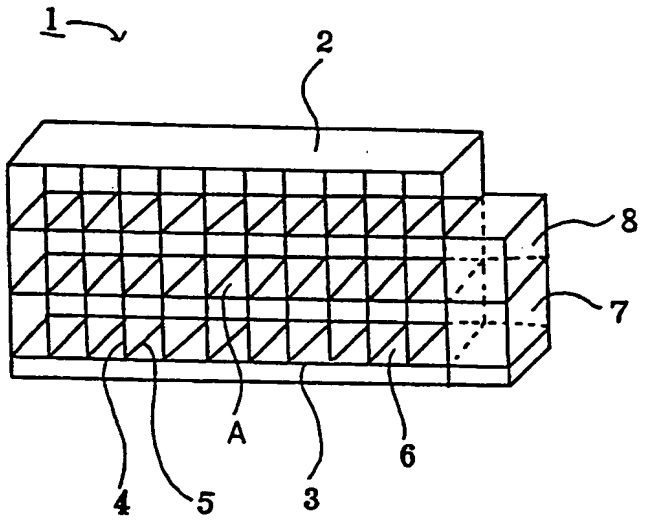
(72) Inventor : **Kimura, Takayuki**
3307 Watari-cho
Sakaiminato City, Tottori 684 (JP)

(74) Representative : **Copp, David Christopher et al**
Dummett Copp & Co. 14 The Square
Martlesham Heath
Ipswich Suffolk IP5 7SL (GB)

(54) Drying apparatus.

(57) Drying apparatus for rubber boots and other articles comprises a housing divided into a plurality of compartments 6, with disinfectant injection equipment 8 and an air dehumidifier 7 in communication either directly or indirectly with all the compartments. The housing is partitioned into compartments arranged in parallel in one layer per one row or multiple layers per one row by partition frames, and has a bottom surface designed to serve as slit shelves 12 so that the drying apparatus for rubber boots and others can dry, in particular, rubber boots used at work or outfits of bags and ski equipment easily and securely at low temperatures which will not damage the material. Forced air convection is used and the disinfectant is carried on the air stream and is distributed in the housing to provide sanitary drying and dehumidification.

Fig. 1



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This invention relates to drying apparatus for drying rubber boots and other articles. The invention is particularly intended for use in drying rubber boots used in places of work, but can also be used to dry other articles such as golf bags, ski boots and other articles.

In factories of various descriptions, and particularly in the food industry where hygienic control is important, workers must wear rubber boots while they are at work to help in ensuring the desired hygienic control in the factory. Such rubber boots become damp from sweat when they are worn for extended periods of time, and wearing damp boots is uncomfortable and unpleasant. Where the working environment is damp, as is often the case in some food factories which use large quantities of water, the boots do not get a chance to become dry and moreover they are required to be worn every day. Rubber boots do not absorb moisture and unless they are properly dried, they become uncomfortable to work in.

Furthermore the damp interior of rubber boots also provides a good environment for bacteria to increase, producing unhygienic conditions. This is a serious problem from the viewpoint of hygienic control in factories. As a result, various apparatuses for drying rubber boots have been proposed in the past.

The existing apparatus for drying rubber boots suffers from various disadvantages. Two particular prior art apparatuses will be described with reference to Figures 16, 17, and 18 of the accompanying drawings.

Figure 16 is a side view of a boot drying apparatus as disclosed in Japanese Utility Model Unexamined Publication No.hei 1-160966. This apparatus comprises a warm air generator B which has a heating unit B-1 and a fan B-2 located at the bottom of an enclosure A. A central duct C is connected to the warm air generator B and a number of branch ducts C-1 branch off from the central duct C and communicate with boot hangers D. The branch ducts C-1 and the boot hangers D all have a multiplicity of vent holes.

With this drying apparatus, damp boots are inverted and put over the boots hangers B as illustrated, and the warm air generator is operated to blow warm air into the boots via the ducts C and C-1, so that the inside of the boot is forcibly dried.

In this drying apparatus, a boot hanger D has to be provided for each boot to be dried and this takes up a considerable amount of space and restricts the number of boots which can be dried in one operation. The apparatus also uses heated air which may cause damage to the rubber of the boots themselves.

Another prior art apparatus is shown in Figures 17 and 18 and is described in more detail in Japanese Patent Unexamined Publication No. sho 58-49745. This apparatus comprises a main duct which is fitted at the back of a box-form drying cabinet E. Shelves H each supported above a duct G with an air outlet K are removably fitted in the cabinet E.

In this type of drying apparatus, boots are placed on the shelf H, a warm air generator I is operated and the generated air is blown up through the outlets K via the shelf duct G from the main duct F to dry boots with a flow of heated air.

In this apparatus, the use of heated air, on a regular and repeated basis, may cause deterioration of the material of the rubber boots in various ways. In particular in some cases the plasticiser used in the material of the rubber boots may migrate to the surface of the boots causing damage to the material of the boots themselves.

It is an object of the present invention to achieve drying of rubber boots or the like at low temperatures. In this specification, low temperatures means temperatures that do not deteriorate or cause damage to rubber boots, and more specifically temperatures below about 40°C.

It is also an object of this invention to provide a means of disinfecting rubber boots at the same time as they are dried.

According to the invention, there is provided drying apparatus comprising a plurality of compartments each with a door, the compartments being arranged so that the door of each compartment is accessible for placing articles in or removing articles from the compartment, the apparatus also comprising a dehumidifying unit and a disinfectant injection unit, all the compartments being in communication with the dehumidifying unit and the disinfectant injection unit, so that air can flow through all the compartments.

It is preferred if the compartments have two doors, one at the front and one at the back so that boots can be placed in a compartment from one side and removed from the compartment from the other side. This arrangement allows the putting in of damp and insanitary boots to be separated from the removal of clean and dry boots, thus enhancing the level of hygiene.

The apparatus may be equipped with forced air circulation, and to this end both air supply and air extraction fans can be fitted.

The compartments are preferably arranged in a vertical array so that both front and back are accessible. All the compartments in each row are preferably in communication with one another so that a current of air can flow along the row.

The floor of each compartment may be formed by slats, and an intermediate slatted shelf may be provided between the top and bottom of each compartment.

Preferably the disinfectant is introduced in the form of an atomised spray, through a spray nozzle. Spray nozzles may be fitted at one end of each row, at a position half way up the height of the compartment and towards one side wall of the compartment so that when boots are placed in the compartments the correct way round there is an open passage through all the compartments in the row above the insteps of the boots and in front of the leg portions of the boots.

According to a second aspect of the invention, there is provided a dry apparatus for rubber boots and others comprising of hollow housing equipment with open front and rear surfaces, disinfectant spraying equipment and low-temperature de-humidifier connected in free communication with the housing equipment, wherein the housing equipment is partitioned into housing boxes arranged in parallel in one layer per one row or multiple layers per one row by partition frames and has the housing box provided with a freely opening and closing door on the front surface together with a freely opening or closing door or a fixed plate on the rear surface, as well as having its bottom surface designed to serve as slit shelves.

According to a third aspect of the invention, there is provided a drying apparatus for rubber boots and others comprising of hollow housing equipment with air passage sections provided on both sides and at least the front surface open to the atmosphere, and disinfectant spraying equipment and low-temperature de-humidifier connected in free communication with this housing equipment, wherein the housing equipment is partitioned into housing boxes arranged in parallel in one layer per one row or multiple layers per one row by partition frames, and has the housing box provided with a freely opening and closing door on the front surface as well as having its bottom surface designed to serve as slit shelves, and on both sides of this housing box an air supply fan and a suction fan installed oppositely.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of a drying apparatus in accordance with the first embodiment of the invention;

Figure 2 is a perspective view showing a detail of one compartment at the position A of Figure 1;

Figure 3 shows the housing at one side of the apparatus including the dehumidifier and disinfectant spraying equipment;

Figure 4 is a plan view showing an installation of a drying apparatus in accordance with a second embodiment of the invention;

Figure 5 is a schematic representation of a drying apparatus forming a second embodiment of the invention;

Figure 6 illustrates air circulation in the apparatus forming the second embodiment of the invention;

Figure 7 is an illustration corresponding to Figure 6 but showing an alternative air circulation arrangement;

Figure 8 shows part of an inside of a compartment;

Figure 9 is a section through a metal bar forming part of a slatted shelf for use with the invention;

Figure 10 is a schematic representation of a third embodiment of drying apparatus in accordance with the invention;

Figure 11 illustrates the air circulation in the embodiment of Figure 10;

Figure 12 is an exploded drawing of an air supply fan for use in the third embodiment of the invention;

Figure 13 is a detailed view showing the air supply fan of Figure 12 installed in the apparatus;

Figure 14 is a schematic representation of a modification of the third embodiment of the invention;

Figure 15 is a perspective view showing a fourth embodiment of drying apparatus in accordance with the invention;

Figure 16 is a side view of boot drying apparatus in accordance with the prior art; and

Figures 17 and 18 are respectively front and side views of a shoe drying apparatus in accordance with the prior art.

Figure 1 shows a drying apparatus 1 for rubber boots and other articles. The apparatus has a housing 2 formed by an X-axis partition frame 3, a Y-axis partition frame 4 and a Z-axis partition frame 5. The frames 3, 4 and 5 divide the housing 2 into a number of compartments 6. At one side of the housing is a low temperature dehumidifier 7 and a disinfectant spraying unit 8.

The housing is of a generally rectangular form with a plurality of compartments 6 arranged in horizontal rows, and each with its front and back face exposed. The exposed front and back faces of the housing are each formed by an X-axis frame 3 and a Y-axis frame 4, with the frames being connected by the Z-axis frame 5 to define the compartments 6.

In the first embodiment, shown in Figure 1, the housing is divided into three rows of compartments 6 arranged in a vertical array, with each row being arranged one above the other. There may be any number of rows of compartments, but normally there will be only one or possibly two base rows, so that each compartment has an accessible face. However in its most preferred form the housing is only one compartment deep, so that boots can be placed in and taken out from the housing from either side which allows good hygienic control, as

will be described later on.

Each compartment 6 is intended to accommodate a pair of rubber boots or the like. The front and rear surface of each compartment is equipped with a glass door which can be opened and closed for putting in and taking out the boots. The base of each compartment is formed by slats, and the side walls are open to allow free communication between the compartments.

The whole interior of the housing is in free communication with the dehumidifier unit 7. The dehumidifier is present to dry the rubber boots or other articles stored in the compartments 6 by extracting the air in the housing and removing the moisture from the air, thereby drying the boots. More details of the dehumidifier unit 7 will be described later.

The housing 2 is also in free communication with the disinfectant spraying unit 8 which sprays disinfectant with a compressor and produces an atomised disinfectant spray which diffuses in the housing equipment through gravity and disinfects the boots or other articles in the housing. Details of the disinfectant spraying unit will be described with reference to Figure 3.

Referring again to Figure 2 which shows the detailed construction of a compartment 6, the front surface of the compartment is formed by an X-axis partition frame 3 and a Y-axis partition frame 4. The frames have hinges 9 and a magnetic catch 10 for a glass door 11. The rear face is constructed in the same manner. The floor of each compartment is formed by metal bars 12 which form a slatted bottom surface supported between Z-axis partition frames 5. The boots can be placed on these shelves. The sides of the compartment are entirely open.

An intermediate shelf 13, also formed by metal bars, can be positioned so that shoes can be placed on the upper shelf 13 and boots on the bottom shelf 12.

Figure 3 shows the operation of the dehumidifier and the disinfectant spraying unit. The dehumidifier 7 is fitted at the bottom of the housing while the disinfectant spraying unit is fitted above. The dehumidifier 7 communicates with the housing 2 via an opening 14. A condenser 15 is connected to the opening 14 and is in communication with a suction fan 16. The suction fan 16 blows air to the outside via an exhaust port 17. A water drain 18 is fitted below the condenser. In operation, air from the housing which contains moisture is sucked out through the opening 14 by the fan 16 and is discharged from the exhaust port 17. Any moisture in the air is condensed by the condenser 15 and is discharged as water from the drain 18, as indicated by bold arrows in Figure 3.

The drying apparatus described here is intended to be kept generally in the temperature range of 20-40°C. For much of the year this will be met by leaving the housing to follow ambient temperature. However in winter some heating may be desirable, and when the housing interior is heated a preferred temperature range is 20-30°C, particularly 23-27°C.

It has been found that if the temperature inside the housing exceeds 40°C, repeated drying tends to cause deterioration of rubber boots. In order to dehumidify and dry the interior of the housing, setting the dehumidifier temperature to the range 23-27°C achieves the best drying efficiency from the relationship between water and steam.

A timer switch T controls operation of the dehumidifier 7.

The disinfectant spraying unit 8 comprises a disinfectant container 18, a compressor 19 and an injection nozzle 20.

The timer switch T also controls operation of the disinfectant spraying unit, but this is operated by a separate timer circuit which controls operation of the compressor 19. When the compressor is operating, disinfectant is forced from the container 18 through the nozzle 20 and then is circulated through the interior of the housing as indicated by the dotted arrows in Figure 3. The disinfectant thus flows around and into contact with boots or other articles placed in the housing.

Next, Figure 4 shows how an apparatus in accordance with the invention can conveniently be arranged in a building. Figure 4 is a plan view which shows a workshop area 21 which is reached through an entry passage 22. From the workshop 21, there is also an exit passage 23. The apparatus 1 is installed with its housing 2 forming a wall between the entry passage 22 and the exit passage 23, so that when workers enter the workshop 21, they can take dried and disinfected boots from the housing 2 on the entry passage side and can then enter the workshop to do their work. When they leave the workshop they can take off their boots in the exit passage 23 and place them from that side into the housing 2. When they take off their boots, the boots may be damp and contaminated with bacteria, and the separation of the dirty boot area from the clean boot area assists in assuring good hygienic control. If the boots remain in the housing overnight, between one period of work and the next, then they should be dry and disinfected in time for the next day's work.

Figure 5 shows a second embodiment of drying apparatus in accordance with the invention. In this embodiment hollow air passages 2a are located at both sides of the housing 2. At the right and left hand compartments 6, adjacent to the passages 2a, air supply fans 25 and suction fans 26 are installed, at each side of each row.

In contrast to the first embodiment where air circulation through the housing is derived only from the suction fan 16, in this case a forced air circulation is provided along each row by means of the opposite supply fans 25 and suction fans 26.

The air flows are shown in detail in Figure 6. First of all air is forcibly fed across the top row of compartments by the first air supply fan 251, and this air is then sucked out from the end of the same row by the first suction fan 261. The air stream Z passing through the first suction fan 261 is allowed to flow into the hollow passage 2a, and is then circulated to the second air supply fan 252. The circulated air stream is forcibly fed horizontally across the middle row to the second suction fan 262 and passes into the left hand air passage 2a. In the same way the air is then forced across the bottom row by the supply fan 253 to the dehumidifier 7, the suction fan 16 of which draws the air through and discharges it to the atmosphere. Consequently, in this second embodiment, air in the housing 2 is forcibly circulated by convection, enabling effective drying and dehumidification of rubber boots and other articles.

A drying apparatus in accordance with this second embodiment of the invention can have four vertically arranged rows, as shown in Figure 7 rather than the three rows shown in Figures 5 and 6. In the modified example of Figure 7, the rows are arranged in pairs, so that the air flow in the two rows constituting the upper pair is in the same direction, and in the two rows constituting the lower pair, is in the opposite direction. In this embodiment also, disinfectant injection nozzles 20 are mounted adjacent to each air supply fan 25, the nozzles 20 being supplied by the disinfectant spraying unit 8.

Because installation of the air supply fan 25 and the disinfectant injection nozzles 20 forcibly circulate the air stream Z or disinfectant K by convection along the horizontal rows, the spraying conditions of the disinfectant droplets can be visually observed, to ensure that they are effectively distributed throughout the housing to maximise the disinfection efficiency.

Operation of the air supply fan 25 is normally stopped while the disinfectant is being sprayed.

Also in the Figure 7 embodiment, a closed air circulation is produced in that the dehumidified air leaving the dehumidifier 7 is further circulated along the right hand air passage 2a, as an alternative to discharging the dried air into the environment.

Figure 8 shows a preferable positioning of the air supply fan 25 and the disinfectant injection nozzle 20. These components are preferably positioned mid way up the height of the side wall of a compartment 6 and towards one side of the side wall. As can be seen in Figure 8, when the components are positioned in this way the air and disinfectant flow along the row of compartments is not obstructed by the calf section S2 of a rubber boot S placed on the slatted shelf 12. The air flows over the instep section S1 of the boots.

In order to avoid mud or dirt from the boots S from dropping into lower compartments, the compartment floor is designed to accommodate a removable bottom plate 30 beneath the slatted shelf 12 to catch any such debris.

Under certain conditions it may be desirable to introduce heat to the housing 2. This can be done by constructing the metal bars 121 which form the slatted shelf 12 with a copper tube heater wire 122 embedded in the centre of the bars. Embedding copper tube heater wire in the bars of the shelves 12 in this way allows the temperature inside the housing to be easily kept within a specific range by operation of a thermostatically controlled switch. By applying heating in this way the temperature within the housing can be kept within the preferred range of 20-30°C, even when the ambient temperature is lower, for example in wintertime.

Figures 10, 11, 12 and 13 show a third embodiment of the invention. In this third embodiment, the air flow Z in the apparatus can cause air circulation in the vertical direction by the use of an air supply fan installed at the top of the apparatus for further effective drying and dehumidification in addition to the forced air convection in the horizontal direction shown in the previous embodiments.

The drawings of the third embodiment show air supply fans 27 installed at the top of the apparatus, but this is not intended to be limiting and additional air supply fans can be installed at any point.

The air supply fan 27 can be constructed as shown in Figures 12 and 13 with a fan 27c and a motor for the fan installed within a box 27b. The box 27b is mounted on a slide member 27a and has electrical terminals 27d. The slide member 27a slides into guides 28 formed on the roof of a compartment 6, and when the slide is fully inserted into the guide rails 28, the terminals 27d engage in a power supply socket 29.

The fan 27 can thus be easily installed or de-installed. The fan can be brought into operation by operating an ON/OFF switch installed outside the housing 2.

Figure 14 shows an alternative arrangement of the third embodiment of the invention. In this embodiment the air circulation is produced by roof mounted removable air supply fans 27, without any additional fans in the side walls of the housing. The suction fan associated with the dehumidifier 7 will still be present.

Figure 15 shows a fourth embodiment of drying apparatus with compartments of different shapes for drying different articles. The apparatus 1 has compartments 6, a dehumidifier 7 and disinfectant spraying apparatus 8, as in the previous embodiments. The compartments can be formed of various shapes as shown by suitable

partition frames.

In this fourth embodiment, not only rubber boots but also, for example, golf bags, coats and other outfits of various shapes can be freely stored, dried and dehumidified. This fourth embodiment is not limited to the particular configuration shown in Figure 15 but may have the compartments 6 of, for example, the second and third embodiments formed in short and/or long forms with partition frames.

The drying apparatus of this invention can be installed not only in the factory workshops as described above to dry rubber boots, but can also be used for example at ski resorts to dry ski boots or can be used for various other applications.

TEST EXAMPLES

The following tests were carried out to further clarify the advantages of this invention.

Test Example 1

Using a drying apparatus 1 for rubber boots and other articles as shown in the embodiment of Figure 7, the number of bacteria in rubber boots were measured both before and after spraying of disinfectant.

A disinfectant comprising a pyracetic acid solution, terpene and nonionic surface active agent produced by the Ikari Disinfectant Co Ltd was prepared and charged to the disinfectant spraying unit 8.

Seven compartments identified with the letters A-G were selected at random in the drying apparatus of Figure 7, some being close to the disinfectant spraying unit and some being remote from the spraying unit. Rubber boots were placed in the selected compartments and the number of bacteria in the boots was measured both before and after a two second disinfectant spraying operation.

Within the boots, general viable bacteria were measured at the position of the right toe and Escherichia coli were measured adjacent the left toe and adjacent the heel.

Testing for the presence of bacteria was carried out using contact slides C marketed by Gunze Ltd for general viable bacteria and contact slide GK-A marketed by Gunze Ltd for Escherichia coli. The number of bacteria was measured at the specified places before and after disinfectant spraying in terms of the number of colonies existing after incubation at 36°C for 48 hours.

The results are shown in Table 1.

Table 1

		The number of general viable bacteria		The number of Escherichia coli	
		spraying disinfectant before	after	before	after
A	toe	crowded	4	2	0
	heel	crowded	2	4	0
B	toe	crowded	3	0	0
	heel	crowded	8	0	0
C	toe	crowded	4	0	0
	heel	1 4 7	1	0	0
D	toe	crowded	2	0	0
	heel	1 1 3	1	0	0
E	toe	crowded	1 6	1	0
	heel	crowded	7	0	0
F	toe	crowded	1 1	1	0
	heel	crowded	1 4	0	0
G	toe	crowded	8	0	0
	heel	crowded	4	0	0

Claims

1. Drying apparatus comprising a plurality of compartments (6) each with a door (11), the compartments being arranged so that the door of each compartment is accessible for placing articles in or removing articles from the compartment, the apparatus also comprising a dehumidifying unit (7) and a disinfectant injection unit (8), all the compartments being in communication with one another and with the dehumidification unit and with the disinfectant spraying unit so that air can flow through all the compartments.

2. Drying apparatus as claimed in Claim 1, wherein each compartment (6) has two doors (11) so that articles can be placed in a compartment from one side and removed from the compartment on the other side.

3. Drying apparatus as claimed in Claim 1 or Claim 2, provided with air supply (25) and air extraction (26)

fans to ensure forced air circulation throughout the compartments.

4. Drying apparatus as claimed in Claim 3, wherein at least the air supply fans (25) are mounted removably within the apparatus.

5. Drying apparatus as claimed in any preceding claim, wherein the compartments (6) are arranged in a vertical array so that both the front and the back of each compartment is accessible.

6. Drying apparatus as claimed in Claim 5, wherein all the compartments (6) in each row are in communication with one another so that a current of air can flow along the row.

7. Drying apparatus as claimed in any preceding claim, wherein the floor of each compartment is formed by slats (12).

8. Drying apparatus as claimed in any preceding claim, wherein the disinfectant injection unit (8) includes one or more spray nozzles (20) through which disinfectant can be injected into the apparatus in the form of an atomised spray.

9. Drying apparatus as claimed in Claim 8, wherein the spray nozzles (20) are fitted at an end of a row of compartments (6), at a position halfway up the height of the compartment and towards one side wall of the compartment.

10. Drying apparatus comprising a plurality of compartments (6) arranged in parallel rows, with the bottom of each compartment being formed by a slatted shelf (12) and with air passages (2a) for the circulation of air at the end of each row, the apparatus also comprising a dehumidifying unit (7) and a disinfectant injection unit (8), all the compartments being in communication with the dehumidifying unit and the disinfectant injection unit, so that air can flow through all the compartments.

Fig. 1

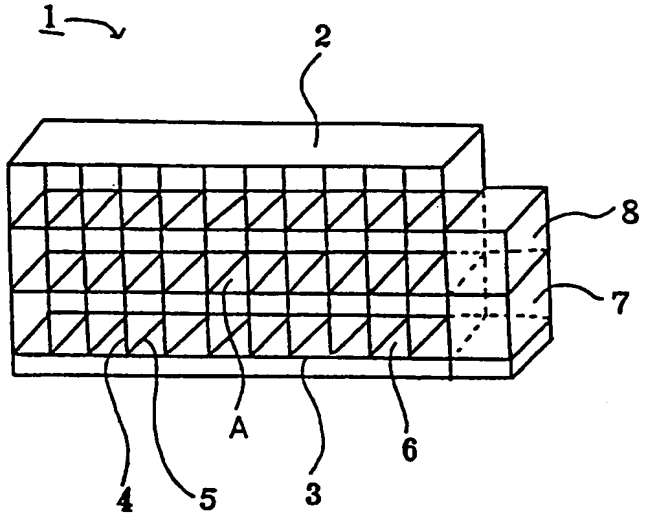


Fig. 2

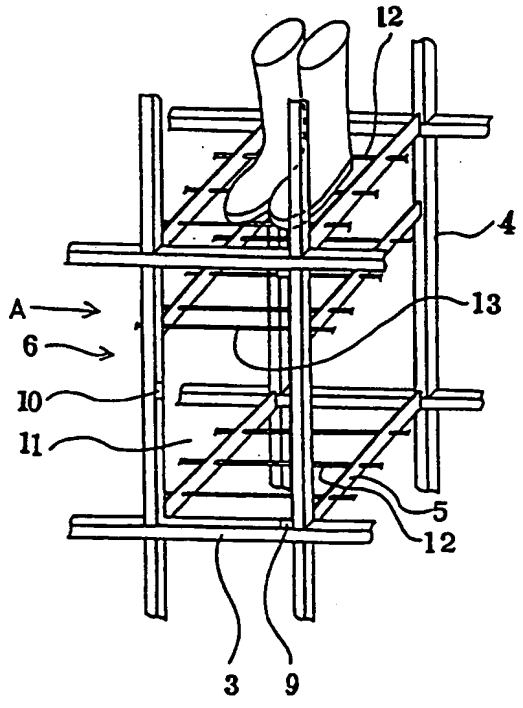


Fig. 3

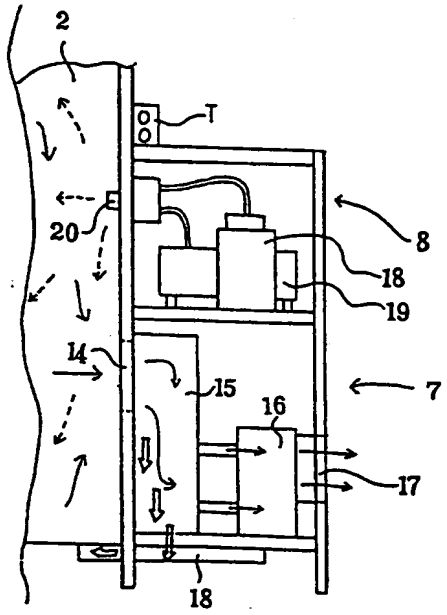


Fig. 4

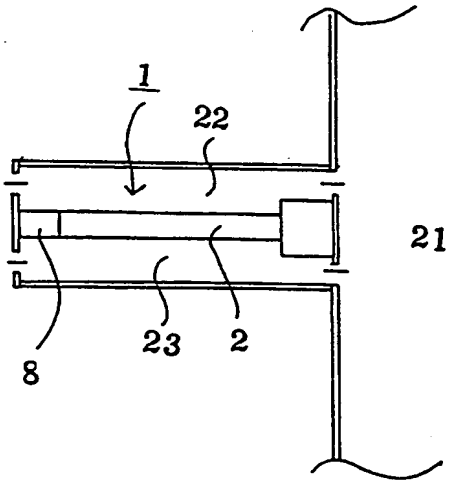


Fig. 5

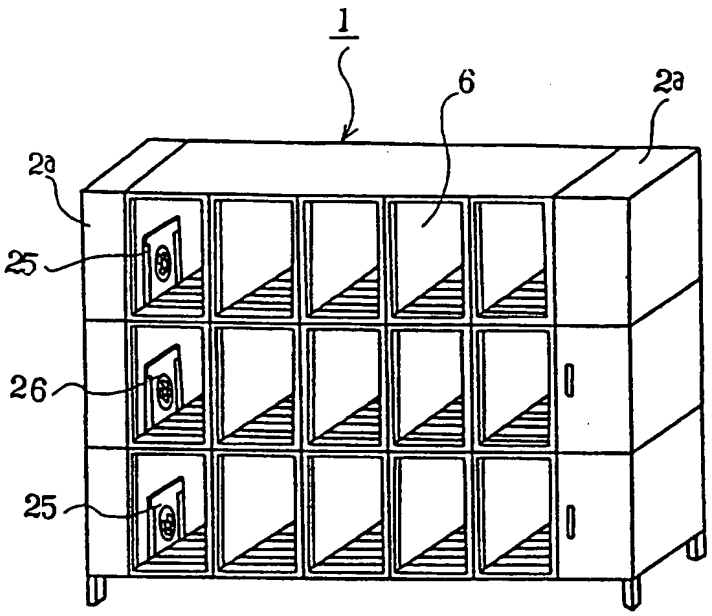


Fig. 6

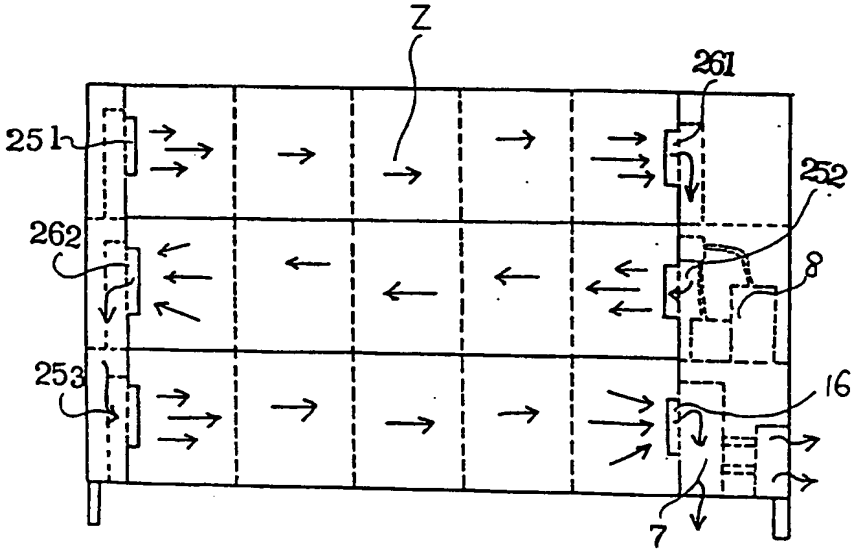


Fig. 7

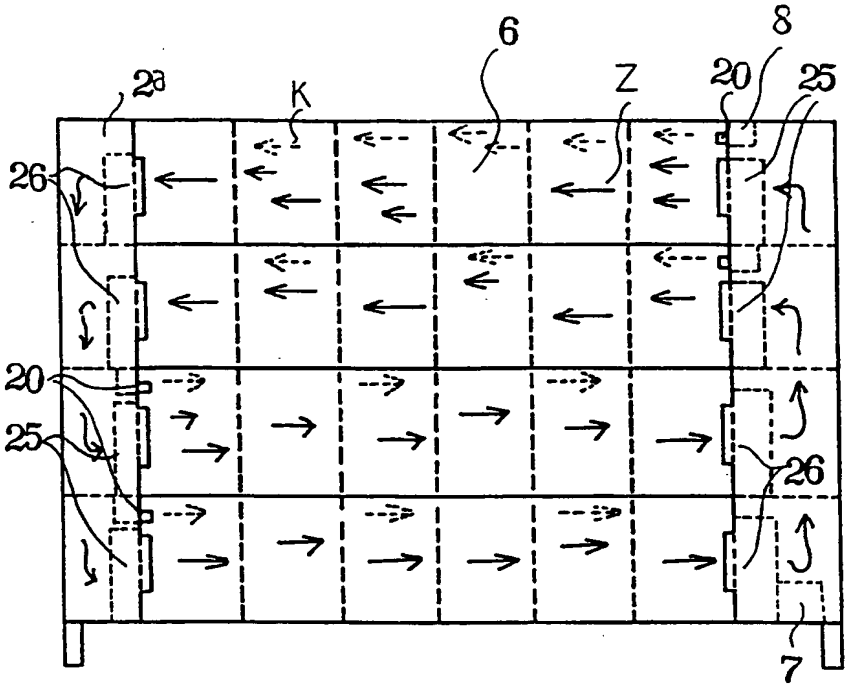


Fig. 8

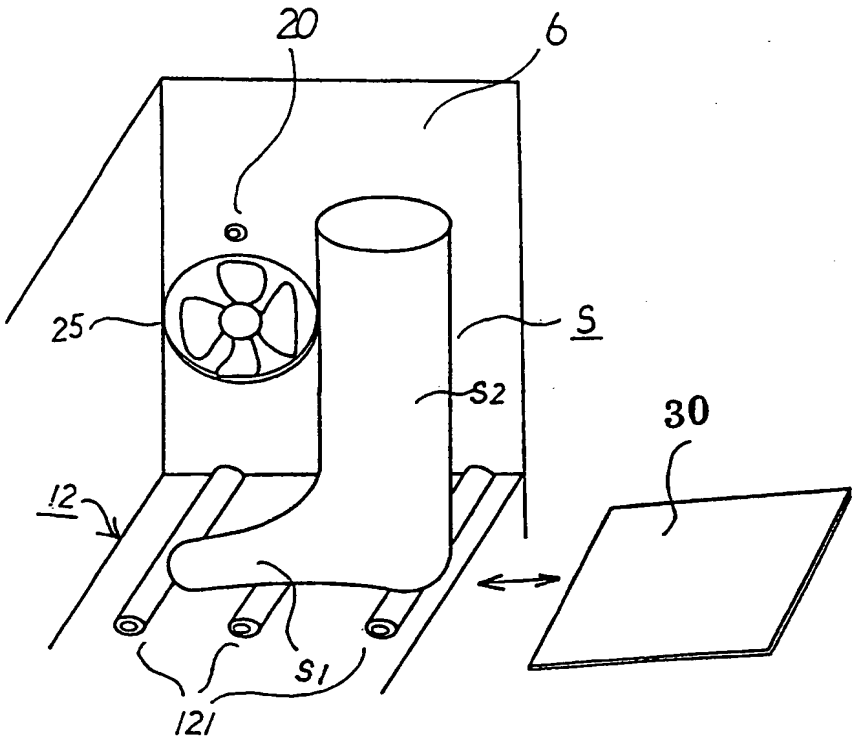


Fig. 9

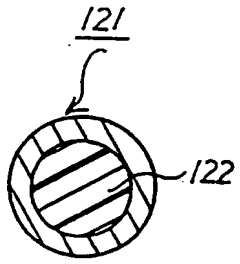


Fig. 10

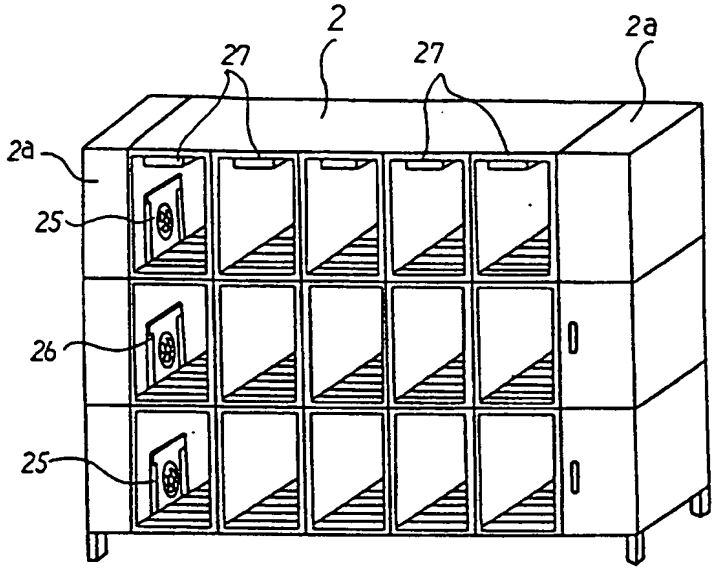


Fig. 11

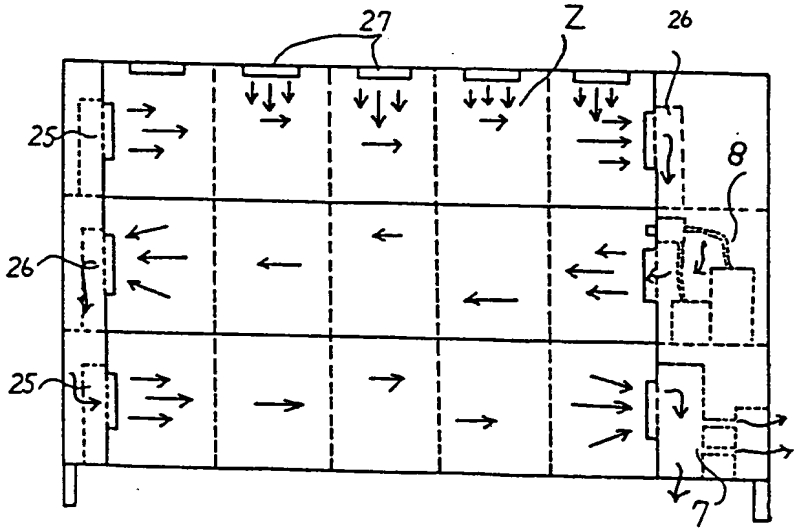


Fig. 12

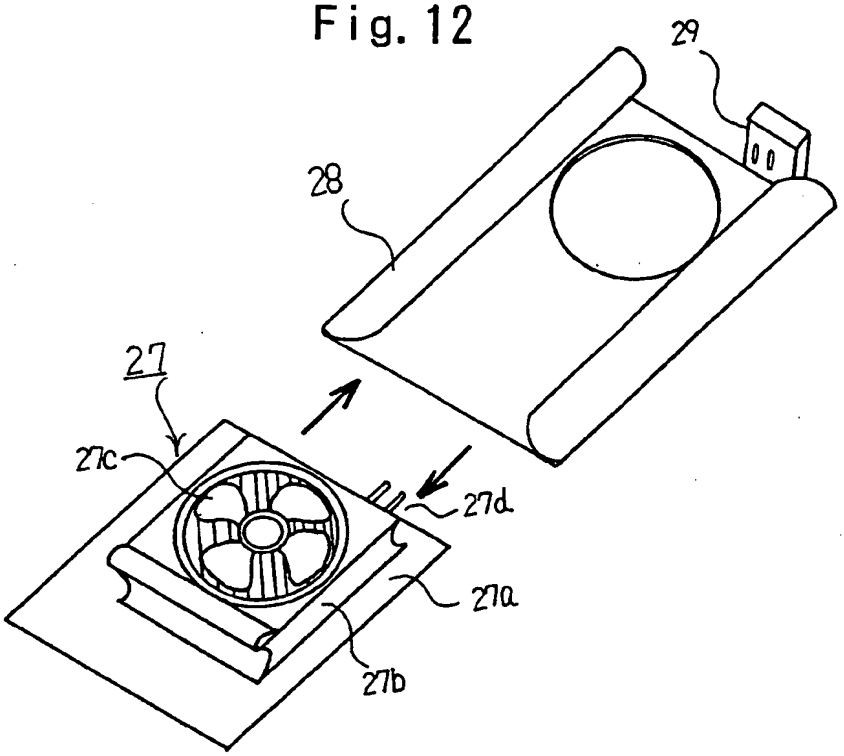


Fig. 13

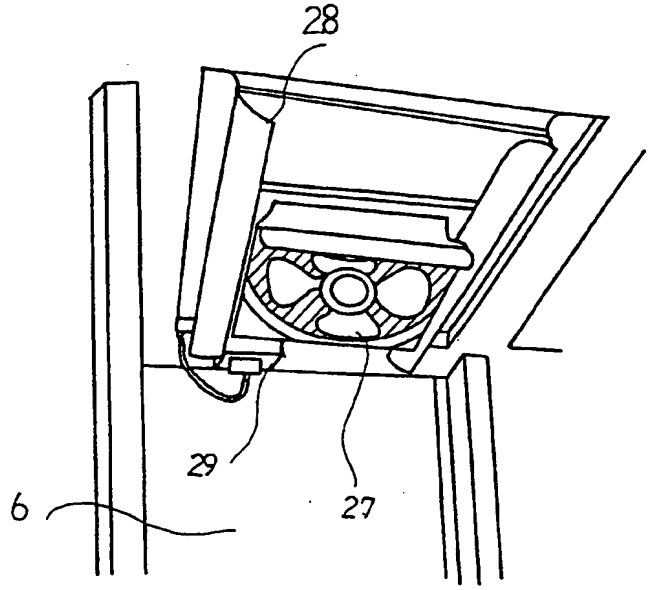


Fig. 14

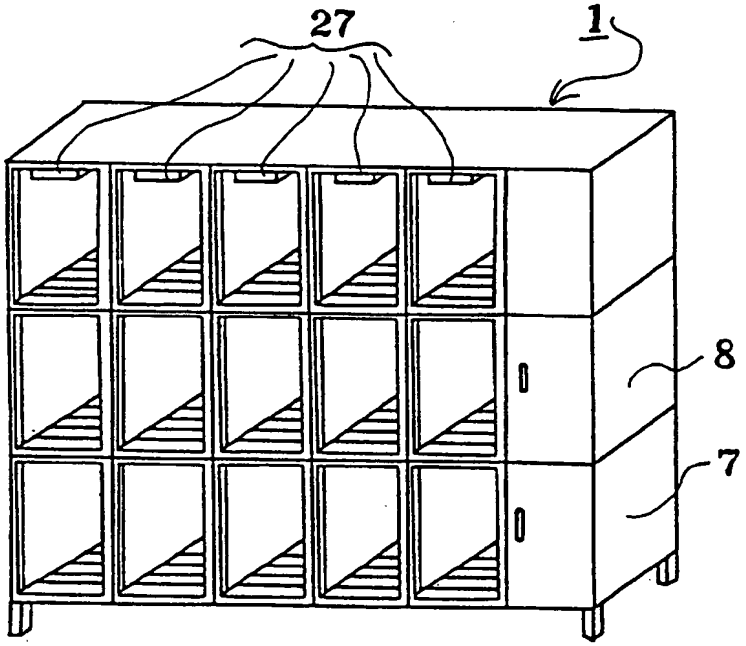


Fig. 15

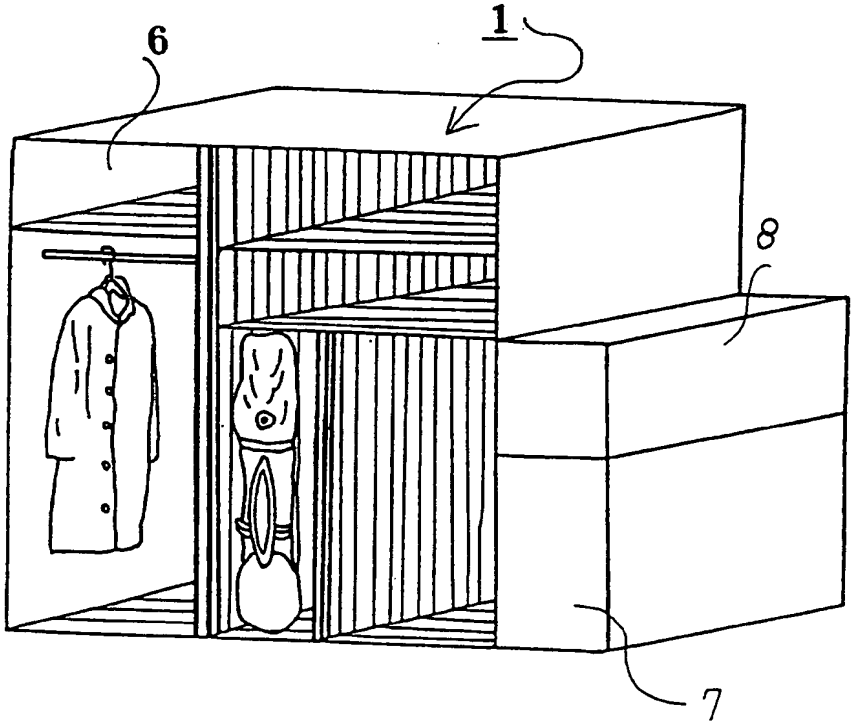


Fig. 16

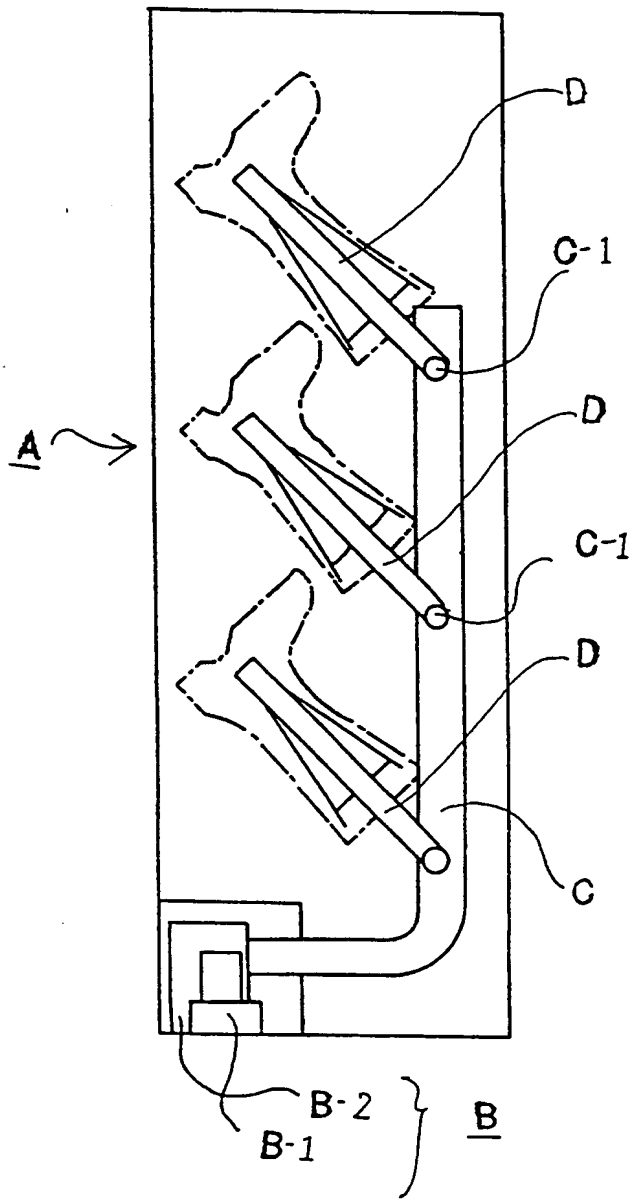


Fig. 17

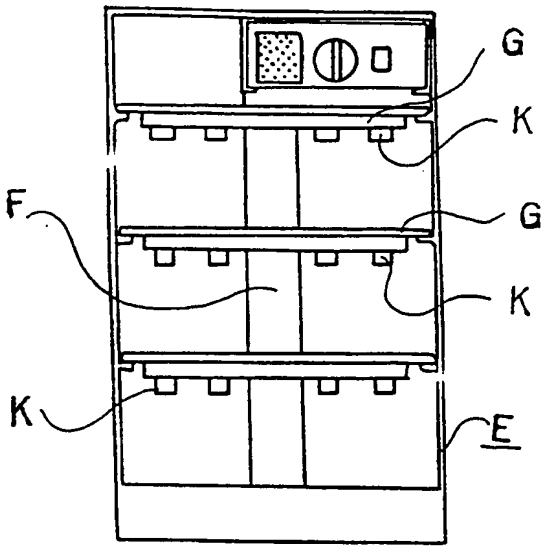
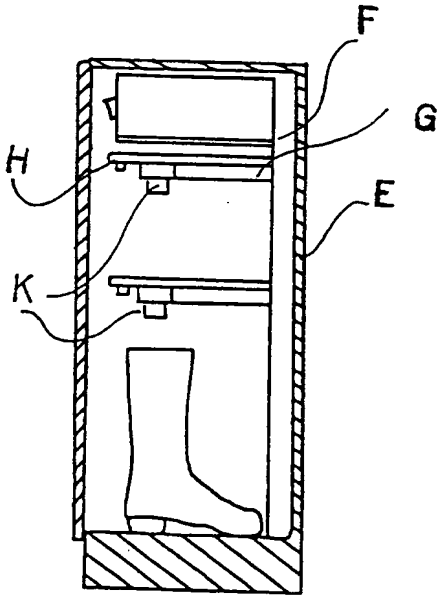


Fig. 18



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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 6775

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-C-79 153 (A. RODDE) * the whole document *	1,2,7,10	A47L23/20 A43D95/10 F26B21/00
A	DE-C-865 949 (A. LERCHENMÜLLER) * the whole document *	3,7,10	
A	EP-A-0 380 433 (R. BLANC, J. KESSLER)		
A	DE-C-522 451 (THE INDUSTRIAL DRYER CORPORATION IN STAMFORD)		
A	FR-A-2 627 971 (SARL MECATECHNIX)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A47L
A43D
F26B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 JANUARY 1992	KELLNER F.M.

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